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Mapping shifting hierarchical and regional tendencies in an urban network through alluvial diagrams

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We employ alluvial diagrams (Rosvall and Bergstrom, 2010) to map the evolution of interweaving hierarchical and regional tendencies in the transnational urban networks created by globalizing producer services firms (Derudder et al., 2003; Taylor et al., 2012). We first applied a hierarchical cluster analysis to 139 leading cities for 2000, 2004 and 2010 respectively, whereby cities are grouped based on their portfolio of firms. In the alluvial diagram, individual blocks represent city clusters, and in each year blocks are ranked hierarchically (i.e. from top to bottom based on the average number of firms per member city). Clusters are named after the formative type of member city, e.g. the continued presence of hierarchically ordered and regionally coherent clusters of United States cities. Horizontal streams connect preceding and succeeding clusters based on shared city membership, which allows tracing how individual as well as groups of cities' positions evolve over time. The width of a streamline is proportional to the number of cities with the corresponding membership change. More technical details can be found in Liu et al. (2012).

Overall change in hierarchical and regional tendencies can be discerned from the shifting designation and ordering of clusters. Here we highlight some notable examples of change, i.e. the combination of upward trajectories and regionalized allegiances of key cities in BRIC countries and the Arab Gulf Region. The black streamlines represent Chinese cities (Shanghai, Beijing, Guangzhou, Hong Kong and Taipei), dark grey is used for Indian cities (Mumbai, New Delhi, Calcutta, Chennai and Bangalore), medium grey for leading Russian and Brazilian cities (Moscow and Sao Paulo), and light grey for Arab Gulf cities. The alluvial diagram allows for a straightforward appraisal of how the position of these cities has changed over time:

- Black: Overall, Chinese cities are becoming more important in the networks of globalized producer services firms. Shanghai and Beijing join Hong Kong in a cluster of leading cities trailing NY-LON (New York and London), whereas Taipei retains its position in a cluster of second-ranked cities. The stream in the lower half of the diagram represents the trajectory of Guangzhou, which is also becoming more important over time, and has come to form a cohesive regional group with Ho Chi Min and Hanoi around the Gulf of Tonkin.
- Dark grey: The primary Indian cities (Mumbai and New Delhi) join a cluster of major second-ranked cities, while the other Indian cities rise from the group of peripheral cities to form a cluster of their own.

- Medium grey: Moscow and Sao Paulo equally become more important in the networks of globalized producer services firms over time.
- Light grey: Istanbul and Dubai are (increasingly) the two leading cities in the region. A regional group of Gulf cities (Manama, Abu Dhabi, Riyadh) emerges from the group of peripheral cities.

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Software

Matlab 2009b, Alluvial Generator (http://www.mapequation.org/alluvialgenerator/index.html)

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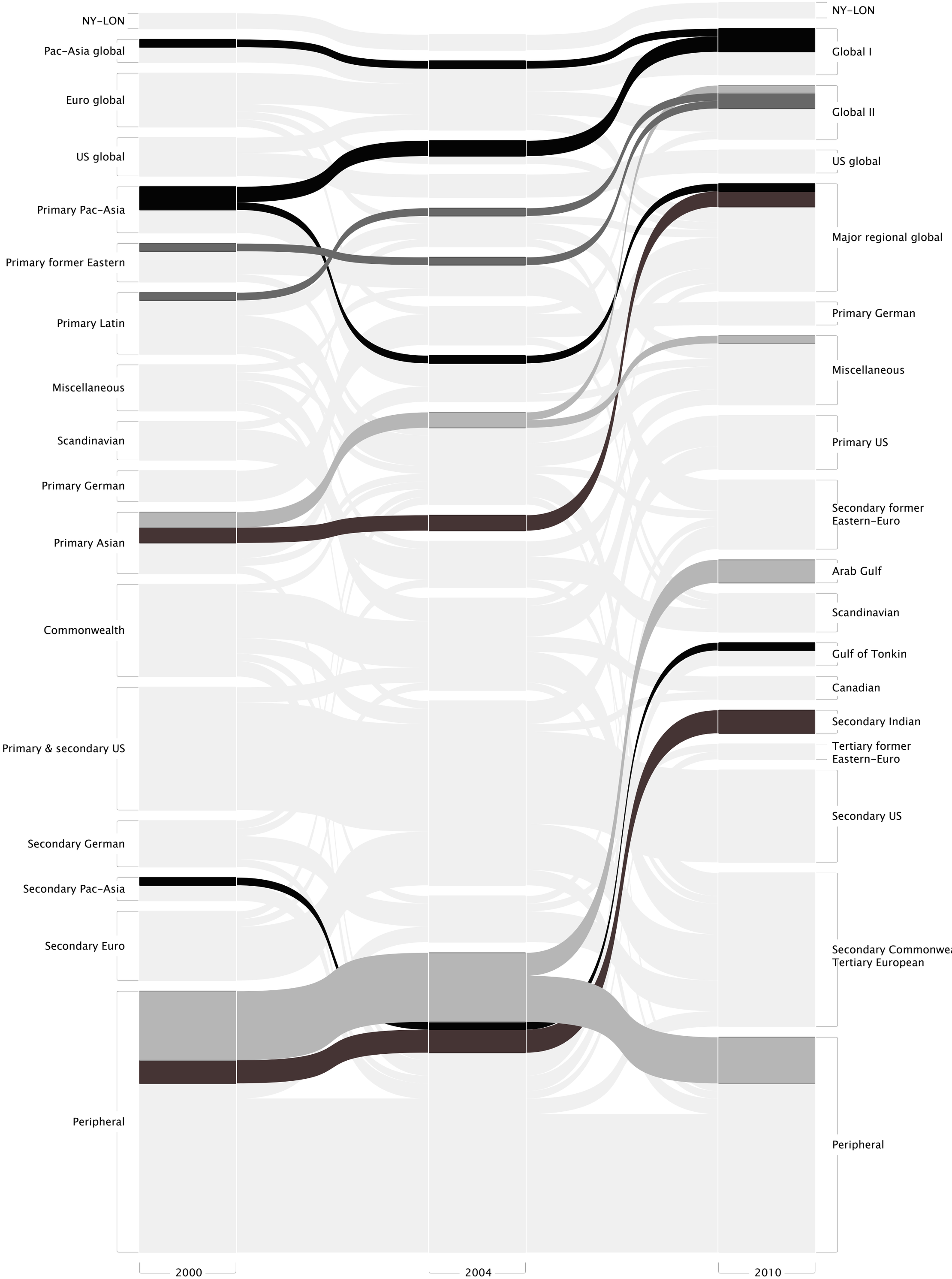
NY-LON
Pac-Asia global
Euro global
US global
Primary Pac-Asia
Primary former Eastern
Primary Latin
Miscellaneous
Scandinavian
Primary German
Primary Asian
Commonwealth
Primary & secondary US
Secondary German
Secondary Pac-Asia
Secondary Euro
Peripheral
NY-LON
Global I
Global II
US global
Major regional global
Primary German
Miscellaneous
Primary US
Secondary former Eastern-Euro
Arab Gulf
Scandinavian
Gulf of Tonkin
Canadian
Secondary Indian
Tertiary former Eastern-Euro
Secondary US
Secondary Commonwealth & Tertiary European
Peripheral
2000
2004
2010